

## Internship / Proposition de stage recherche

### Master /PFE Ingénieur et/ou Master M2

INSA de Strasbourg - Université de Strasbourg - Laboratoire ICube

Mars- août 2022 / March-August 2022

# Femtosecond laser glass-welding

**Lab:** ICube Strasbourg, France

(Laboratoire des Sciences de l'Ingénieur, de l'Informatique et de l'Imagerie)

Engineering science, computer science and imaging research institute

**Equipe / Team :** IPP (Instrumentation et Procédés Photoniques / Photonics Instrumentation and Processes) in collaboration with IREPA LASER

### **Context:**

Glasses are highly resistant materials used in a wide range of key applications from glass-ceramic plates to MEOMS encapsulation. Their assembly is usually done by bonding or by thermal processes. However, for some applications these techniques have restrictive limits. Polymer adhesives do not withstand high temperatures and thermal processes are not suitable for making precise welds on small dimensions. In this context, welding by ultra-short pulse lasers, spatially selective, without adding material is very promising.

### **Description:**

The project aims to develop a femtosecond laser welding process for glass-to-glass and glass-to-metal that is compatible with current industrial requirements. Our simulations have shown the possibility of using higher repetition frequencies (temporal shaping) to better control the thermal accumulation and to achieve a reduction of the thermal gradients, while reducing the required energy and the residual stresses. Experimental tests have also clearly shown the importance of the light pattern and the welding trajectory (spatial shaping) on the mechanical strength of the weld seam. The improvement of the performances requires the understanding of the underlying multi-scale physical phenomena and, technologically, the development of a more efficient laser process.

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### **Traineeship grant /Gratification de stage :**

Gratification de stage conformément aux règles en vigueur (3,90 €/h ~ 600 €/month).

**Poursuite possible en thèse/ Possible PhD position:** yes

### **References:**

- [1] M. Gstalter, G. Chabrol, A. Bahouka, L. Serreau, J-L. Heitz, G. Taupier, K-D. Dorkenoo, J-L. Rehspringer, S. Lecler, [Stress induced birefringence control in femtosecond laser glass welding](#), Appl. Phys. A 123 (714), (2017).
- [2] M. Gstalter, G. Chabrol, A. Bahouka, K-D. Dorkenoo, J-L. Rehspringer, and S. Lecler, [Long focal length high repetition rate femtosecond laser glass welding](#), Applied Optics, 58(32), p.8858, (2019).